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Energy and transport*

Report of the Secretary-General

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* This report was prepared by the Department of Economic and Social Affairs of the United Nations Secretariat as task manager for the areas of energy and transport, with contributions from other United Nations agencies and international organizations. The report is a brief factual overview, which is intended to inform the Commission on Sustainable Development on key developments in the subject area.

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I. Introduction

1. Energy and transport pose a basic dilemma for sustainable development in that both are necessary for socio-economic growth, yet they are associated with environmental degradation, especially with regard to atmospheric pollution. Affordable energy is key to poverty reduction and supports a whole range of related development goals, there are still 2 billion people who lack access to commercial energy. At the same time, the production and use of energy — especially through the combustion of fossil fuels — can and does create adverse environmental effects. Without remedial action these problems will further worsen as overall energy demand and use continue to rise. Furthermore, limited access to transport is often cited as a contributing factor to poverty, and public transport in low-income areas is now given higher priority by many urban planners.

2. Although neither energy nor transport is addressed explicitly in Agenda 21,[1] they are considered throughout the document, but primarily in chapters 9 (atmosphere) and 14 (agriculture and rural development) for energy, and chapters 7 (human settlements) and 9 (atmosphere) for transport. At its nineteenth special session in 1997, the General Assembly decided that energy and transport issues should be addressed at the ninth session of the Commission on Sustainable Development. Specifically, the General Assembly recognized the need for a movement towards sustainable patterns of production, distribution and use of energy and emphasized the overarching significance of energy for sustainable development; it also recommended a number of forward-looking transport policies to promote sustainable development, including working toward the elimination of lead in gasoline. Thus, the critical and pervasive role of both in the context of sustainable development is well understood.

II. Energy

A. Current situation

Energy trends

3. In the period 1992-1999, total world consumption of commercial primary energy increased by almost 10 per cent, despite the fact that global economic growth was reduced by the collapse of the former Soviet Union, political changes in Eastern Europe and the recent East Asian economic crisis. The growth rate of global primary energy use, however, has fallen from 2 per cent per year in the 1980s to about 1 per cent per year in the 1990s. This latter drop in growth rate is the result of regional differences in socio-economic development. First, the severe economic contraction of the transition economies in Eastern Europe and the former Soviet Union reduced their income by 40 per cent and primary energy use by 35 per cent between 1990 and 1998. Second, the rapid growth experienced by developing countries in the 1980s decreased in the early 1990s and slowed even more during the financial crisis of 1997-1998. Third, among the countries that are members of the Organisation for Economic Cooperation and Development (OECD), total energy use grew by 1.4 per cent per year.

4. The developing countries' share of global commercial energy use increased to almost 30 per cent in 1998 as compared to only 13 per cent in 1970. On a per capita basis, however, the increase in primary energy use has not resulted in more equitable access to energy services between industrialized and developing countries. In Africa, per capita energy use barely increased in the 1990s and remains at less than 10 per cent of average per capita use in North America. The same is true for a majority of countries in Asia, with the result that vast numbers of Africans and Asians have no access to commercial energy services and continue to rely on traditional biomass resources. Latin America saw little improvement, while China and especially Western Asia made above-average progress in providing access to modern energy services.

5. Regional energy use is even more inequitable when viewed in terms of per capita electricity use. There is a difference of two orders of magnitude between the least developed countries (83 kilowatt hours per capita) and the OECD average (8,053 kilowatt hours per capita).

6. In 1999, petroleum continued to be the world's dominant primary energy source, accounting for over 40 per cent of the total world commercial primary energy consumption of about 8,534 million metric tons of oil equivalent (Mtoe). Coal ranked second as a primary energy source in 1999, accounting for almost 25 per cent of world primary energy consumption. Dry natural gas ranked third as a primary energy source, accounting for about 24 per cent in 1999. Nuclear,

hydro and other (geothermal, solar and wind) electric power generation accounted for 7.6, 2.7 and 0.7 per cent, respectively.

7. During the period under consideration, of the increase in world primary commercial energy demand, about 75 per cent was met by oil and natural gas, 18 per cent by nuclear sources and 6 per cent by renewable sources, including hydropower. Coal consumption dropped during the period owing to declines in Eastern Europe and the former Soviet Union.

8. The large proportion of the growth in demand that came from oil and natural gas was due to price competitiveness and growth in supply capacity as well as the lack of competitive, non-petroleum alternatives for transportation fuels. The rapid increase in demand from the electric power sector, particularly in developing countries, and fuel-switching in electricity generation for reducing carbon emissions in industrialized countries, underpin the greatly expanded use of natural gas. Environmental considerations provided the major stimulus for increasing the use of natural gas in other sectors as well. The increase in electricity use has outpaced GDP growth in all regions, often by a large margin, reflecting the continued importance of electricity for economic development.

Energy trade patterns and globalization

9. The world energy system has become more integrated, as evidenced by the rising share of energy that crosses borders before reaching end-users. Energy trade has rebounded following the drop in oil prices in 1986 and, by the end of the last century, this share was approaching 55 per cent of primary energy use. Global energy trade remains dominated by crude oil and oil products. Despite the steady growth in coal trade and accelerated penetration of natural gas in the 1990s, the share of crude oil and oil products in trade only fell from 90 per cent in 1971 to 77 per cent in 1997. While expanded trade in coal, natural gas and even oil products was largely unaffected by world oil market prices, trade in crude oil definitely responds — though with a lag — to market price changes. In 1998, about 46 per cent of oil trade originated in the Middle East — up from 38 per cent a decade earlier. The low production cost in this region exposes investments in oil production capacity elsewhere to above-average risks.

10. For importing countries, concerns about oil import dependence and supply security appear to have given way somewhat to reliance on market forces and high expectations that new exploration and development will bring new oil to the market at a rate commensurate with demand. Moreover, as a result of globalization, the shift of oil from a strategic good to a commodity is accelerating, further lowering supply security concerns. In several countries, oil imports absorb a large share of export earnings. These countries benefited from the low oil market prices of the mid-1990s relative to the prices of 1985 (the year before the oil-price drop) and 1990 (when prices soared during the Gulf war).

11. Still, the world oil market remains fragile. As a result of strong world oil demand and production cuts in some producing countries, market prices nearly tripled within about a year (from $9.39 per barrel in December 1998 to $27.55 per barrel in March 2000 for API Gravity 2 oil).

Energy investments

12. Current energy investments amount to $290–430 billion per year (1.0-1.5 per cent of global GDP) and, if investments in end-use devices and appliances and energy efficiency improvements in buildings are included, capital requirements are doubled. Investments in renewable energy remain a small portion of the total investment in energy. Despite the energy sector reforms under way in many countries, the required levels of investments for sustained economic growth are not taking place in least developed countries particularly in Africa. Investments in electricity generating plants, refineries and energy-related infrastructure are long-term in nature and thus the equipment installed in the last 10 years will probably still be in operation in 2030 and beyond. The resulting overall shift to higher efficiency coal-fired and gas-fired electricity generating plants will be only gradual.

B. Main achievements

13. In the period under review, actions by Governments, international organizations, non-governmental organizations and the private sector have resulted in increased awareness of the lack of universal access to energy services, inequity in energy use, energy-related environmental degradation, the threat of

climate change, and unsustainable patterns of production and consumption. This increased awareness has contributed to a re-evaluation of energy use at the national and global levels.

14. One of the main results of this growing awareness of energy and environmental issues in the period following the United Nations Conference on Environment and Development has been an improvement in the efficiency with which energy is used in industry and power generation, as well as in lighting, household appliances, transportation, and heating and cooling of buildings brought about by policy measures and improved technology and management. This increasing efficiency in the uses of energy is a major factor contributing to the improvements in energy intensity (less energy input for the same product output) that have occurred historically in almost all OECD countries, and more recently in many transition economies, as well as some fast-growing developing countries such as Brazil and China. Demand-side management has gained momentum in many industrialized and developing countries with a positive impact on energy use. Barriers to the realization of greater end-use efficiency have been addressed through energy policies that use direct and indirect price mechanisms (such as the removal of subsidies and incorporation of externalities). Energy efficiency standards, appliance and product labelling, and voluntary agreements have made a considerable impact.

15. In support of the renewed interest in the development of renewable (solar, wind, biomass, small hydro and geothermal) sources of energy, many Governments have introduced national policies, including incentives, supported national programmes, developed institutional capabilities and adopted commercialization strategies, including innovative financing and credit mechanisms. The new renewable energies reached a 2 per cent share of world commercial energy consumption in 1998. Solar photovoltaic and grid-connected wind-installed capacities have been growing at the rate of 30 per cent per year. The efficiency of solar cells have shown steady improvement and costs of solar photovoltaic (PV) modules have come down by about 25 per cent during the period under review. Global shipments of PV modules have reached 200 MW per year. A total of 15 GW of wind electric capacity has been installed worldwide, much of this in the 1990s. New biomass technologies are gaining ground. Several countries have adopted legislative measures and introduced portfolio standards as well as non-fossil fuel obligations for electric utilities to promote renewable energy. Despite the large resource base and other environmental advantages of renewable energy, its growth is slow and its aggregate contribution to total energy output remains small.

16. Significant progress has been made in developing and applying advanced fossil fuel technologies to the long-term goal of near-zero emission of air pollutants, including greenhouse gases (GHGs). For power generation, advanced technologies are gradually replacing conventional ones. Despite public concerns in some countries about nuclear energy, several developing and industrialized countries are planning to increase its share in the energy mix. Natural-gas-fired combined cycles featuring low cost, high efficiency and low environmental impacts are being chosen wherever natural gas is readily available as a preferred option even over new large hydropower projects. Progress has been made in commercializing integrated coal gasification combined-cycle plants with air pollutant emissions nearly as low as those from natural gas combined-cycle systems. Prospects for early commercialization of distributed generation technologies, such as micro-turbines and fuel cells, have improved in the last decade through intensified research. Fuel cell applications for transport vehicles have also made significant advances. Work on supercritical and ultra-high-pressure boilers as well as polygeneration facilities, where electricity becomes a by-product of other value-added products, has opened up new opportunities.

17. During the period under review, one of the most significant developments has been the extent of deregulation and restructuring of energy markets, coupled with a strong trend toward regional integration and energy trade. Local and regional pollution, as well as GHG emissions, has received wide political attention, and the contribution of energy development to these problems, and to health and well-being in general, is under scrutiny. This has spurred initiatives to incorporate externalities in energy prices and also introduce levies such as the carbon tax. Decision makers have started to pay greater attention to energy prices as experience has shown that energy prices can influence consumer choices and behaviour and can affect economic development and growth.

C. Barriers

18. Policy, technical, institutional and financing barriers continue to hamper progress in sustainable energy development. Given the constraints on public financing of energy infrastructure, a substantial part of the investments will have to come from the private sector. The slow pace of policy and institutional reforms that are needed to create an enabling environment for private sector investments in energy has been a major barrier to investments.

19. Provision of modern energy services to vast populations in the rural areas of developing countries in an environmentally sound manner remains a major challenge. Among the many other challenges, access to energy and energy technologies, reduction of inequity, environmental protection, mobilization of financial resources and building institutional and human resources capacities in developing countries need particular attention.

20. Progress towards a sustainable energy future has lacked a sense of urgency, particularly in curbing GHG emissions from energy use. Moreover, there is no consistent trend with regard to the benefits and deficiencies of the liberalization of the energy sector in different countries.

21. Financial cooperation between industrialized and developing countries has not improved since 1992. If the anticipated growth rate of energy demand of 2.5 per cent per year in the developing countries and countries with transition economies is to materialize, investment requirements will be of the order of 2-2.5 per cent of their GDP. Considering that current energy investments amount to $290-430 billion per year (which will double if energy efficiency improvements across all sectors are included), mobilization of such large investments from domestic and foreign sources will be a major challenge. Lack of appropriate institutional tools to promote large-scale foreign direct investment is the main barrier in this regard.

III. Transport

A. Current situation

22. Transport is associated with emissions to the atmosphere with adverse effects to the environment at the global, regional and local levels. Its emissions include GHGs, most notably CO_2, which have adverse effects at the global level. It is also the source of emissions of particulate matter, lead, nitrogen oxides, sulfur oxides and volatile organic compounds, all of which have negative environmental and health impacts at the local and, often, at the regional levels. In addition, it is associated with adverse noise and land-use impacts. Moreover, accidents and congestion associated with unsustainable transport systems represent costs to society and thus adversely affect sustainable development.

23. The transport sector embodies all aspects of sustainable development — it has profound economic, social and environmental implications, and decisions at the local, national and international levels are important in overall sustainable development efforts and programmes. Investments made to meet growing transport demand are often long-term in nature, and decisions taken today will affect the prospects for achieving sustainable development in years to come.

B. Trends and achievements

24. The transport sector accounts for about 25 per cent of the total commercial energy consumed worldwide and consumes approximately one half of the total oil produced. Energy consumed by this sector increased by 2.3 per cent per year from 1990 to 1997, with oil accounting for 95 per cent of the total energy consumed. Consumption patterns in this sector are widely acknowledged to be unsustainable, and demand for transport services is expected to grow considerably as economic growth occurs in developing countries, incomes rise, the trend toward urbanization continues and the process of globalization moves forward with expected increases in world trade and personal travel. Between now and 2020, energy demand for transport is forecast to grow by 1.5 per cent per year in industrialized countries and by 3.6 per cent per year in developing countries.

25. Industrialized countries have well-developed transport systems and have made progress toward solving many problems associated with pollutants affecting the local environment as well as towards eliminating lead from gasoline. However, CO_2 emissions from transport remain a serious problem, and industrialized countries account for 57 per cent of global CO_2 emissions from transport, with 32 per cent from North America. In addition, per capita emissions

of CO_2 in aggregate and from transport are highest in OECD countries. Progress has been made in reducing localized emissions by, inter alia, implementing air quality and emissions standards, mandating the use of catalytic converters and introducing cleaner fuels. Furthermore, the use of public transport, including rail systems, in urban areas and for inter-city travel has been actively encouraged in some countries, and non-motorized transport has been promoted by incorporating walking trails and bike paths in urban plans. Moreover, many OECD countries are implementing agreements to control cross-boundary emissions. OECD recently developed an innovative sustainable transport strategy to achieve sustainable transport within one generation.

26. In developing countries increases in per capita income and growth in population have contributed to the rising demand for transportation services and associated energy. Economic growth in developing countries has often been marked by improvements in physical infrastructure during the past 25 years, including transportation systems. Some developing countries now boast modern road and air transport facilities, while many have modern ports and improved sea access. Also, there has been some focus on urban transport problems since congestion and poor air quality have adversely affected local populations. The United Nations and the World Bank have jointly initiated the Global Initiative on Transport Emissions (GITE) to promote private-public partnerships as a means of improving the knowledge base and fostering the transfer of cleaner vehicle and fuel technologies.

27. Air transport is also expected to increase significantly. Aircraft-produced emissions are similar to other fossil fuel vehicles but are unusual in that a significant proportion of the emissions occur at very high altitudes. At the global level, it is estimated that aircraft GHG emissions contribute about 3.5 per cent of the total radiative forcing[2] by all human activities and that this proportion is likely to increase. Emissions from aircraft relevant to climate change include CO_2, water vapour, NOx, SOx and soot. These gases and particulates are emitted directly into the upper troposphere and lower stratosphere, where they contribute to the concentration of GHGs. Investigations have been initiated by the International Civil Aviation Organization on economic incentives and other possible means for reducing emissions from air transport.

C. Barriers

28. Barriers to overcome in achieving sustainable transport encompass a wide array of technical, institutional, financial and behavioural characteristics and conditions that are often firmly entrenched in current economic and social systems throughout the world. The reliance on private vehicles provides an excellent example of the barriers existing in many countries. A preference for private vehicles has been reinforced by public spending on highway systems and funding mechanisms that favour highway expansion and urban sprawl in some countries, coupled with benign neglect and inadequate funding of mass transit systems that would provide alternatives for users. In many countries today, life styles dependent upon private vehicles will be difficult to change, and the focus has been on improving technologies and standards. Innovative ways to influence transport behaviour patterns need to be examined and tried.

29. For developing countries the provision of transport services remains a serious development problem and securing financing remains a serious barrier. Furthermore, developing countries are hampered by inadequate institutions to regulate and control emissions, introduce fuel and vehicle standards, initiate inspection and maintenance programmes, and take transport needs into account in urban and rural planning. Barriers to the transfer of cleaner technology remains a problem for many countries, and impediments to the upgrading of vehicle fleets need to be overcome. In addition, the improvement of often deteriorated mass transit systems requires substantial financial capital in many countries.

IV. Issues for further consideration

30. There is a pronounced need not only to continue ongoing efforts to curb GHG and other polluting emissions, but also to expand them greatly, so as to close the ever-widening gap between what has been done and what is realistically needed to mitigate this and other serious environmental impacts related to energy production and use.

31. By using resources and technical options that rely on a combination of higher energy efficiency, renewable resources and advanced energy technologies, paths to energy development can be found that address all aspects of the goals of

sustainable development. Appropriate national policies and strategies as well as international cooperation are key to achieving the intended objectives.

32. In addition to the need to orient national energy policies to the economic, social and environmental goals of sustainable development, there are a host of issues that still need to be dealt with at the national level. Dominant among these issues are the need to ensure equitable access to modern energy services; create an enabling environment and regulations that will permit markets to work better; develop a diversity of locally available energy resources; and electrify rural areas through grid extension or decentralized options.

33. At the regional and international levels, the main issues are strengthening regional and international cooperation for energy security and market stability; transferring energy efficient, renewable energy and cleaner advanced fossil-fuel technologies to developing nations; building institutional and human resource capacities; and mobilizing financial resources in support of national efforts.

34. Economic growth, globalization and the expected associated increases in world trade and personal travel will pose a formidable challenge for the transport sector as it attempts to reduce CO_2 emissions without adversely affecting the provision of services. Regional cooperation for controlling cross-boundary pollution from the transport sector will become increasingly necessary as demand for transport services rises. The transport of toxic and radioactive materials, as well as attention to the problem of oil spills by oil tankers and leakages of natural gas pipelines, will continue to merit the attention of the international community and will remain an area of consideration at the regional and national levels.

35. Meeting the challenges posed by the transport sector calls for a focus on both technological innovation and influencing travel behaviour patterns in both industrialized and developing countries. There have been notable advances and technological improvements in engines and vehicles and in producing cleaner fuels. Alternative fuel vehicles are being tested in the private sector, including promising fuel-cell and hybrid vehicles.

36. Future efforts to influence travel behaviour patterns might focus on fiscal policy (taxes and subsidies), schemes to base vehicle use on cost per trip, and improvement of mass transport systems, including rail systems, which in many developing countries are overburdened and unable to meet operating costs. Privatization programmes may be effective in this regard.

37. In developing countries, the challenges include rural and urban planning, zoning that has a positive effect on transport patterns, and investment decisions that are undertaken with sustainable development in mind. Implementing effective inspection and maintenance programmes is also important, since vehicle life is relatively long and older vehicles are associated with higher emissions.

38. Many rural areas of developing countries suffer from a lack of adequate transport systems, in some areas relying totally on animal power and walking, and the provision of services remains a challenge.

39. Concerted efforts must be made to eliminate the use of leaded gasoline.

Notes

[1] *Report of the United Nations Conference on Environment and Development, Rio de Janeiro, 3-14 June 1992*, vol. I, *Resolutions Adopted by the Conference* (United Nations publication, Sales No. E.93.I.8 and corrigendum), resolution 1, annex II.

[2] Radiative forcing is a measure of the importance of a potential climate change mechanism.